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RADIUM

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VOL. V APRIL, 1915 No. 1

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A MONTHLY JOURNAL DEVOTED TO THE CHEMISTRY
PHYSICS AND THERAPEUTICS OF RADIU
AND RADIO-ACTIVE SUBSTANCES

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RADIUM

A MONTHLY JOURNAL DEVOTED TO THE CHEMISTRY, PHYSICS AND THERAPEUTICS OF RADIUM AND RADIO-ACTIVE SUBSTANCES.

Edited and Published by Charles H. Viol, Ph. D., and William H. Cameron, M. D., with the assistance of collaborators working in the fields of Radiochemistry, Radioactivity and Radiumtherapy.

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VOL. V. APRIL, 1915 No. 1

A CONSERVATIVE ESTIMATE OF RADIUM THERAPY FROM THE CLINICAL STANDPOINT.*

BY WALTER B. CHASE, M. D., BROOKLYN, N. Y.

If a new perspective is required to grasp the magnitude of the cancer problem and the need for new and more effective agents for its treatment, the reader is referred to an excerpt from the report of the board of health of this great metropolis in the issue for December 5th last, which records a mortality in a single week of 115 from cancer. In round numbers this means 6,000 deaths by malignancy per annum in Greater New York, 12,000 in this State; and a total of 120,000 deaths per annum in the United States. Doubtless this is below the true number for the reason many individuals and families dislike to have the true cause of death given in mortuary statistics, and so many are otherwise reported. Again, failure to make early accurate diagnosis in other cases is a fertile source of error. The need of early and exact diagnosis of all tumors, warts, moles, and the pathogenesis of bleeding from the vagina and uterus is disclosed in the fact that a large proportion of malignant diseases is not accurately diagnosticated until the growth has attained considerable proportions or metastasis has occurred. If the attendant has any doubt of entire differentiation, the patient is entitled to the opinion of an expert. The supreme importance of this last proposition becomes more apparent when we recall the fact that cancer in its incipiency is always a single localized lesion and, if accessible, is curable by excision or destruction of its malignant cells. This leads to the impressive fact that information to the public, and to women in particular, of these truths by organized effort along ethical lines followed by the American Medical Association in delegating this important function to women physicians, as is done in this and other States in the United States.

*Read by invitation before the Brooklyn Medical Society, Dec. 18, 1914. New York Med. Journ., Jan. 9, 1915, p. 63.

If any other argument is needed to enforce these propositions, it is found in the appalling fact that before the age of forty-five years one woman in every fourteen dies of cancer of the reproductive organs, and that one in nine after forty-five years falls victim to the same cause.

Observation and conclusions. The writer, with a long surgical experience in the treatment of cancer, believes with others that operative surgery has approximately reached the limit of its curative and palliative efficiency. This casts no discredit on the ever increasing benefits surgery has conferred on vast numbers of cancer patients, but stimulates the hope that widespread study and research will soon disclose the cause and antidote—particularly the latter. This state of affairs forces us to any new method which brings new power to conquer this hideous ailment, and so we turn to radium for any aid it may offer.

The scope of radium therapy is a question the profession and the laity desire to be answered, and it should be judged by fair and unprejudiced methods of investigation, study, and observation. As an aid to our judgment an appendix follows the text of the paper in the form of an abstract for 1913 from the London Radium Institute, one of the largest and best equipped institutes in the world, noted for its moderate and conservative conclusions. It contains valuable information respecting their experience in various forms of cancer and is commended for careful study. The full text is found in the *British Medical Journal for May* 23, 1914.

Lack of confidence and unbelief in radium. The writer believes that unbelief is susceptible to reasonable explanation, and is due to two causes: First, lack of quantity and potency of much of the radium used; second, want of knowledge and skill in its application. From these causes honorable practitioners have met with disappointment and relinquished its use, often not appreciating the reason for their failure. These errors time and truth will dissipate. Again, enthusiasts in the ranks of the profession have drifted far from conservative and wise measures in the attempt to cure incurable cases, and so the reputation of this effective remedy has suffered in the house of its friends. Those of an open mind, seekers after truth who can lay aside prejudices and watch the intelligent application of adequate quantities of potential radium in properly selected cases, will be able to estimate its worth. In the broad field of science and medicine nothing is more startling and impressive than the silent but destructive influence it exerts on lawless cell proliferation.

In this quest of truth it is my purpose to cite a few personal cases and observations of myself and others illustrative of the results obtained, and corrobating the value of this added force to the agents worthy of consideration. In so doing, a comparison of the relative merit of radium and surgery will be noted and deductions stated.

What surgery can accomplish. Surgery, by wise and adroit use of the knife, can quickly remove large areas of diseased structures, benign or malignant, which, if they were allowed to remain, would be a menace to health or a certain cause of death.

What radium can accomplish. It can destroy benign and malignant growths without pain, shock, or danger, and with cosmetic results unequalled by other methods, and often without scar. Fortunately it exercises this conservative action (within well defined limits) without injury to normal structures, the resistance of which is about six times greater than that of cancerous growth. Every surgeon of large experience meets with patients who refuse cutting operations or those who have passed the opportunity for radical cure, and are forced to abandon the case unless some alternate measure can be employed. Other patients

absolutely refuse operation when indicated. It is here that radium opens a large field for curative and palliative work. It may afford substantial relief if not cure, and keep alive that vital sentiment of hope, the most precious endowment of the human soul. In any event it is the best that can be offered. Among these unfortunates are the timid souls who fear operation and dread the disfigurement that sometimes accompanies it, and the despairing who turn to it as a last hope whereby they may escape much of the suffering while life remains, without a stupefying opiate. Another class, the subjects of benign growths and a variety of cutaneous ailments, finds in radium an efficient remedy.

Postoperative radiation. Still another large and generally unoccupied field is postoperative radiation as related to operative surgery. Preoperative use of radium is not so well established by clinical data. The immense value of postoperative radiation in destroying lawless proliferation of cancer cells of unknown location and impossible differentiation, following operation, and in localities which for anatomical reasons are inaccessible, promises improved results and suggests a practical basis of reciprocity between surgery and this silent agent. No matter how consummate his skill and perfect his technic, the surgeon ever and always fears recurrence after extirpation of cancer by the knife. I have used postoperative radiation in nearly every cancer operation I have performed in ten years. While I cannot set a standard of action for my professional brethren, I am so fully persuaded of its efficacy that in omitting it I feel I have not met my entire obligation to my patient.'

A rather commonly accepted but irrational theory is that because cancer is not always curable by radium this agent should be discarded. Because the physician and surgeon in his every day work fails to cure, does he dismiss the case or relax his human effort to relieve his patient?

Crossfire. The crossfire of the gamma rays (which cannot be deflected) concentrates and intensifies their activity, focusing their energy at points most needed, thereby greatly augmenting their penetration efficiency. This amplifies the field of their practical usefulness manifold, a fact not yet appreciated by many. In inoperable growths of the breast, sarcomatous tumors, goitres, malignant growths within the vagina and elsewhere, radium may be buried or applied at different points and produce strikingly salutary results. The period of application depends entirely on the individual case. I am now using from five to 150 mgm. of radium from five minutes to four days over the diseased parts or buried in the growth, screened by paper, lead, or rubber as indicated. The law of reaction is the governing factor in its use, and only by mastery of this art can success be attained. It is assumed a given amount of radium applied at the same distance with the same screening will produce the same results if the tissues to which it is applied, normal or malignant, possess the same resistance. When lack of uniformity in curative results is found, the inference is unmistakably that the individual resistance of the patient's tissues is one of the two controlling factors in radium therapy. Knowledge of such resistance can only be determined by actual application. Evidences of improvement are marked by diminution of odor in cases where ulceration is present, diminution in size of growth, lessening of cachexia and blood dyscrasia, increase of appetite and strength—in fine, progressive improvement in health.

Uterine cancer. Uterine cancer in its first stages is curable by prompt hysterectomy, whether corporeal or cervical, though the latter

form, if of the squamous cell variety, often yields to high amputation. When the opportunity for radical operation passes, radium has a field of great usefulness, sometimes curative, more often palliative. *Kronig's* results are very suggestive and practical: "In fifty-six inoperable cases of cancer of the uterus fifteen were healed so far as good health and histological negation were observed, the longest absence of recurrence at time of report being sixteen months." *DeCourmelles* reports "one hundred inoperable cases, seventy improved, with the gain held from one to four years." *Jacobs*, of Brussels, reports: "Among 120 cases, twenty-four cases of uterine wall cancer, all favorably affected." *Kronig* says he has seen a large cauliflower of the cervix replaced by normal cervix in five and one half weeks with only a delicate mark for a scar. I have repeatedly witnessed healing after amputation of carcinoma of the cervix by the *Byrne* method of cautery. Several of my patients are now alive and well after periods of twelve to fourteen years. Similar cases after amputation with the knife or thermocautery have healed under radium in my own experience. Hysterectomy by the most approved methods, cervical amputation with the scalpel, or *Byrne's* amputation, is too often disappointing and will continue to be until earlier diagnosis and prompt action gives opportunity for radical measures before the stage of metastasis.

A practitioner with large experience in the use of radium reports the cure of two cases of cervical cancer in 1905, with twenty-five and sixty mgm. of radium respectively. According to other observers, with larger doses, the number of cases cured is small.

Mammary cancer. The great frequency of mammary cancer, the most frequent variety seen at the London Cancer Hospital, is a most distressing feature of woman's lot. The cure *par excellence* is early extirpation. Unfortunately relatively few cases are seen early enough for successful operation. By early extirpation I do not refer to amputation of the breast without the careful dissection of lymphatic glands in the axilla and elsewhere after the improved technic of *Halstead, Campbell, Pilcher, Bloodgood,* and others. Here the reasons for after radiumization from my standpoint are of supreme importance.

Cancer of the mouth, rectum, and other mucous membranes is more difficult of cure than similar growths on cutaneous surfaces. I report two cases of rectal cancer:

CASE I. Mrs. B., aged fifty years, married, multipara, I saw with Doctor *Jackman* in April, 1912. The growth the size of a small pear, was just above the sphincter ani and involved the posterior vaginal wall. There was pain, bleeding, and purulent vaginal discharge, and she was weak and cachectic. Radium was applied at short intervals for a month. Pain and discharge ceased, her strength returned, and she was in comfortable health for a year. Then the disease returned and she refused further treatment.

CASE II. Adenocarcinoma of the rectum. Mrs. B., aged fifty years. Patient of Dr. J. A. *McCorkle*. She had suffered from rectal hemorrhages for years, but refused examination. She was anemic and debilitated from loss of blood and had great vesical irritability. This was reflex from a rectal growth, which was removed on her entrance to the Long Island College Hospital by Dr. J. D. *Rushmore*, and reported by Doctor *Murray*, pathologist, as adenocarcinoma. No hemorrhage since removal. On September 21st, directly after the operation, she came under my care. I gave her six radium treatments between that date and October 23d, in doses of fifty to 100 mgm. There was induration at seat of cancer two and one half inches above sphincter, posteriorly,

which was extended to the left, involving more than one half the circumference of the gut. The radium was divided into two parts, one half being placed in the rectum, the other in the vagina, being in close proximity to each other, so as to secure the advantages of crossfire, thereby greatly augmenting its efficacy. On an examination being made by Doctor *Rushmore* and myself one week later, there was found entire absence by touch of infiltrated area. She returned to her home in a distant New England town, apparently well. The vesical irritability due to the influence of the rectal growth was arrested for a period of four days with the early application of the radium, which disappeared altogether before treatment ceased. This should be regarded as temporarily cured.

CASE III. Spindle cell bone sarcoma.[1] C. V., aged thirty-seven years, male, family history and Wassermann both negative. January 27, 1913, fracture of left hip by fall in manhole. In a few months noticed swelling over seat of fracture. On December 21st swelling extended from crest of ilium to knee; mass deeply immovable; did not fluctuate. On January 8th, after entering hospital, was growing rapidly. *Coley's* serum was injected daily for one week. In ten days fluctuation appeared; tumor opened in two places. Broken down tissue was removed and pathologist reported spindle cell bone sarcoma. Patient grew rapidly worse, was anemic and emaciated; fluctuation was present. Two openings, one high up on outer side of leg, the other at inner middle surface of thigh, communicated; sinus established. March 9th, forty mgm. of radium was drawn through this sinus, covered in rubber tube and removed in four hours; on March 6th, same amount of radium used for twelve hours. After second use of radium, pain and discharge lessened and the tumor had decreased one half in size. Pain greatly relieved. Hypodermics discontinued, appetite improved, hemoglobin increased, and growth remained stationary. Blood pressure dropped from 120 to 102 where it remained. White corpuscles decreased from 14,000 to 10,000, polynuclears from 71 to 40, and remained stationary; after third application of radium, tubes were withdrawn, and, on April 15th, both sinuses closed and cicatrized. He improved in weight and color, and except for slight lump and tenderness over upper cicatrix, was apparently in normal health. *Coley* cites this case in his paper, Sarcoma of the Long Bones, in the November number of the *Annals of Surgery*, and reports the patient well on June 5, 1914. On December 3, 1914, I presented him to the Brooklyn Surgical Society, in good health. The upper portion of femur is still enlarged.

CASE IV. Madam L. D., aged sixty-nine years; governess. Six months previously had a tumor removed from her back, which pathologist reported to be a round cell sarcoma. One month later, recurrence took place at former site, border of left scapular spine, at inner extremity, with characteristic odor. February 20, 1914, growth and remaining scar removed. Wound healed kindly, but on March 10th there seemed to be some infiltration of skin and forty mgm. of radium were applied for two hours. On May 10th, examination shows no evidence of any return of the growth. (Cases III and IV are referred to here with Doctor *Bissell's* permission.)

Epithelioma is the most common form of malignancy and easiest cured by surgery and radium. I present a case showing the mastering power of radium:

CASE V. Dr. J. McH., aged forty-five years. Trinity Hospital, October, 1913. Clinical diagnosis by Doctor *Bristow* and Doctor *Campbell*, epithelioma. By Doctor *Murray*, pathologist of Long Island College

[1]St. Vincent's Hospital. International Journal of Surgery, May 19, 1914.

Hospital, hyperkeratosis. Following x ray burn, six years since, left hand became edematous, livid, and greatly swollen. Doctor *Bristow* advised amputation. This was declined, and through and through drainage from palm to dorsum of hand was accepted. After three months' stay in the tropics, swelling disappeared. For the subsequent five years there was continuous pain in left hand and fingers, when a tumor, the size of small chestnut, appeared on middle finger, dorsal aspect, metatarsophalangeal joint, which was excised by Dr. William Francis *Campbell,* surgeon in chief of Trinity Hospital, July, 1913. This refused to heal and left an exquisitely painful ulcer the size of a finger nail. While using radium in a gynecological case at this hospital, October, 1913, Doctor *Campbell* suggested that I apply it to this ulcer. In five minutes the patient said the pain had disappeared, but it returned in thirty-six hours. Three subsequent applications of radium were made, and in less than a month the ulcer healed with almost imperceptible scar, including the scar remaining as a result of its removal This may be regarded as a form of recurring epithelioma. He returned, July, 1914, with a smaller ulcer on the ring finger, near last phalanx. One application of fifty mgm. of radium for ten minutes was followed by considerable reaction. The next and last use of radium was 100 mgm. for twenty minutes, more heavily shielded. A remarkable but instructive fact in this case shows that the first ulcer was healed with twenty-five mgm, of radium with equal facility as did the last with four times the quantity.

It may be remarked that, paradoxical as it may be, certain cases of malignant growth yield readily to small doses, while other cases, apparently similar, resist the curative action of many times the quantity. This, however, is not an argument for scanty use of radium. Desirable doses are those which readily demonstrate a destroying influence on malignant tissue.

Radium in nonmalignant conditions. The field for radium therapy broadens in proportion as its efficacy becomes known. This applies to tumor growths, surgical tuberculosis, lupus, and scrofula, and in internal medicine. Keloids of spontaneous growth or developing in cicatricial tissue usually yield promptly. Disfiguring scars following operation and accidental causes can be completely removed, or much lessened in size. *Wickham* and *Degrais* affirm that radium is very useful as a depilatory on the face. A vicious scar from a bungling operation for hemorrhoids was dissipated by two months' use of radium a year since, in a man fifty-five years of age under my care.

Goitre. Goitre is of so frequent occurrence that relief from any method but the knife is hailed with satisfaction, particularly in females. Resolution by radium is easier in the glandular type than in the fibrous *Goodchild,* of Toronto, reports results by radium treatment of fifteen cases. Nine of them showed evidences of hypothyroidism which were of the simple variety, in five of which the improvement was most gratifying. The nervous symptoms disappeared and the enlarged thyroids decreased to a remarkable extent. In the other cases the ophthalmic symptoms were not severe, but quickly disappeared under three series of radium treatment. *Wickham* and *Degrais* have obtained diminution in size in cases of simple goitre by radium with aid of crossfire methods. In large inoperable goitres the burying of radium tubes within the gland is reported to have resulted in cures.

I report a case illustrating the efficacy of radium in connection with surgery in diminishing hypertrophy of the thyroid, about ten months since:

CASE VI. In March last, Mrs. M., aged fifty years, under the care of Dr. William Francis *Campbell,* of Trinity Hospital, a patient of Dr. Everett H. *Winter;* a large left lobe goitre caused pressure symptoms so pronounced that he removed this lobe, which weighed one and one quarter pound. There was moderate hypertrophy of the right thyroid, which Doctor *Campbell* desired should be reduced in size fifty per cent. I made five applications of radium, and within less than a month its diminution was in keeping with his wishes. Her recovery was uneventful and on December 18, 1914, the gland remained unchanged in size.

Lupus vulgaris. The recent work of *Wickham* and *Degrais* is replete with reference to certain dermatological ailments. In lupus vulgaris they speak of very successful results. I have a case of lupus erythematosus now under treatment which is refractory and has not as yet after two months yielded to radium, though somewhat improved. I report a case of lupus vulgaris:

CASE VII. A patient of Doctor *Scrimgeour,* Mrs. H., widow, aged sixty-five years, had a patch on right temple involving outer canthus of eye following a burn of many years' standing, which failed to respond to x ray and prolonged constitutional and local medication. It was circular in form, measuring two and one quarter inches with a scar from a burn in the centre the size of a half dollar. Itching and irritation were persistently annoying. After ten treatments of from forty to 100 mgm. of radium, covering a period of forty days, the eruption had disappeared. The diagnosis and results were confirmed by Dr. Emil C *Bernaur,* a dermatologist of this city.

Radium in uterine hemorrhage. Kelly and *Burnham* in a recent article (*Journal A. M. A.*) assert the great efficacy of radium in several varieties of uterine hemorrhage of diverse pathogenesis not due to malignancy, pregnancy, or inflammation of the adnexa: First, myopathia hæmorrhagica, with almost no pathological findings; second, bleeding in young girls; third, polypoid endometritis; fourth, myoma causing hemorrhage and pressure. In most instances the application is preceded by curettage and free cervical dilatation and applying the radium within the cervical or uterine canal. In fibroids, the ovaries, not the uterus, are the point of attack. That radium has powerful hemostatic properties I have repeatedly demonstrated. Later I hope to report my results.

Evidence is not wanting of its usesfulness in other nonmalignant neoplasms and conditions. In this category are nævi, angiomata, fiat and erectile; keloid and disfiguring scars; tuberculous glandular growths, and lupus. Tuberculous glands when not caseating respond to the gamma rays, as do such other dermatological conditions as papillomatous warts, acne, eczema, psoriasis. Some of these lesions, it must be remembered, may be malignant. One case of eczema over the shin bone of a man aged seventy years, disappeared in eighteen days after a single application of radium.

Radium water, which may now be had, containing a definite amount of radium element, and radium emanations for inhalation have an established therapeutical reputation. In some cases of nephritis and diabetes, radium water proves efficacious.

Chronic rheumatic rheumatoid and traumatic arthritis. The efficacy of radium in these varying forms of arthritis by intravenous injection is startling and impressive. In such cases the disability, pain, and deformity make the patients objects of commiseration. A few injections of fifty to 100 micrograms is often effective. I have had the opportunity of watching such cases in St. Vincent's Hospital. One a woman of about forty-five years, over two years helpless in bed, with distorted

limbs, had so regained her power of mobility as to be able to get out of bed, and was practically without pain. Sixteen cases of polyarthrius and oligoarthritis treated in the free radium clinic at Pittsburgh by intravenous injection, showed the following results: temporarily cured four; considerably improved eight; improved two; not improved two. The term "temporarily cured" was used in a precautionary sense, as evidence of permanency was not yet established. Its present degree of success is most encouraging. It also applies to chronic forms of articular rheumatism, and it is found useful in neuritis. Consummate care is needful in the technic of its use, owing to liability of disintegration of the salts on the slightest chemical provocation. This brings hope to a class of cases usually regarded as almost, if not quite, hopeless.

Restoration of function by radium. The *modus operandi* of radium is not understood. The impressive fact remains of its great restorative potency. It has a positive influence in restoring the functions of fibrous structures. Used both locally and by intravenous injection, it proves its efficacy in chronic inflammatory involvements.

Its power as a hematinic is proved by blood tests after its entrance into the circulation, and as a remedy in arteriosclerosis it gives promise of great usefulness by diminishing blood pressure. When radium salts are introduced mechanically into the circulation, the greater part is deposited in the marrow of the long bones, thereby producing a reservoir for its prolonged activity, from which its emanations are constantly distributed through the blood currents.

The analgesic effect of radium is little appreciated because little known, lasting hours, days, and weeks in many cases, both operable and inoperable and is entitled to consideration. In a case of cancer of the tongue and throat, W. W. C., aged fifty-two years, a patient of Doctor *Scrimgeour,* radium applied persistently in quantities up to 100 mgm. failed to cure, though at times the case seemed promising. I regret I did not bury the radium in the tongue for several hours, as experience shows cures when it is thus applied. From late in June last he discontinued the use of opiates he had taken to relieve pain, until the time of his death early in August, which is a striking instance of the analgesic power of radium. The case of Mrs. J. K., aged thirty-three years, of Jersey City, may be mentioned, a patient of Dr. John O. *Polak.* She came under my care two months ago with inoperable uterine cancer, the treatment being wholly palliative. She is almost free from pain for sixty to seventy-two hours subsequent to the application of fifty to 100 mgm. of radium. Treatment of cases like this may not add to the reputation of the attendant, but it is a boon to the sufferer. The analgesic and decongestive influence of radium is shown in neuritis and neuralgias, which I will not pause to illustrate by case reports. I desire to give special emphasis to the imperative need of scrupulous care of the patient's nutrition and hygienic surroundings, a matter, it is feared, which is too often overlooked.

Finally, it is to be mentioned that radium may be hurtful as well as beneficial; too small quantities may stimulate, rather than retard or destroy cancer growths. Through overdoses or lack of care in its application, radium may penetrate hollow organs as the bladder and intestines, or do irreparable damage to normal structures and nerve trunks, sometimes causing septicemia by too rapid destruction of normal and malignant tissues.

CONCLUSIONS.

1. The destructive power of radium on cancer cells is well established.

2. The employment of radium in cancer is not in conflict with surgery, but both possess distinctive fields of usefulness, each having its limitations; they are largely supplemental to each other, and there is ample opportunity for co-operation and reciprocity.

3. Large, operable malignant growths should be removed by the knife.

4. The analgesic power of radium is one of its most precious properties.

5. Want of confidence in radium arises from the use of low grades or spurious products, and from want of knowledge and skill in its application, together with the exaggerated, conflicting, and false reports so constantly current.

6. Postoperative radiation is of great usefulness, and rapidly coming into professional use at home and abroad, being commended by prominent authorities, who not long since were unconvinced of its curative and palliative powers.

7. Crossfire application of radium increases its efficacy and aids by its multiple application in securing deeper penetration of large areas than by ordinary methods of application.

8. As in surgery so in the application of radium, disappointment is likely to follow too optimistic expectations of recovery.

9. In proportion as metastasis is present, the chances of cure diminish, and in turn delayed diagnosis is often responsible for metastasis.

APPENDIX.

Abstract from the annual report, Radium Institute, London, by the superintendent, Major Pinch, for the year 1913.

Epithelioma.—The results in the treatment of epitheliomata affecting glabrous surfaces call for no fresh comment, and in suitable instances removal of the growth by radium may be confidently anticipated.

The buccal, lingual, and pharyngeal mucous membrane is still refractory and disappointing, but a new method of healing cancer of the tongue by burying radium within the carcinomatous mass up to 100 mgm. properly screened has given distinctly encouraging results.

Carcinoma of Uterus still continues to yield more gratifying results in inoperable cases far advanced than by any other known medical or surgical method. Used after *Wertheim's* operation small quantities of radium, not exceeding fifty mgm. should be employed.

Carcinoma of Breast.—Many cases show great susceptibility to radium. The primary growth becomes smaller, infected glands and subcutaneous nodules lessen, or perhaps disappear. It is also applied as a last resort.

Carcinoma of Rectum.—Results not very satisfactory. The routine method consists of 30 hour exposures—5 days of 6 hours each—up to 100 mgm. of radium, depending on susceptibility of patient; the series of exposures being repeated at the end of 6 weeks.

In the most favorable cases carcinomatous material shrinks and becomes replaced by dense fibrous tissue.

Carcinoma of Prostate.—Number not large, but benefit has been noted in all of them. Fifty to 100 mgm. used.

Carcinoma of Bladder.—Nine cases treated, and in six the results have been most gratifying, by use of fifty mgm. of radium.

Rodent Ulcers, when of the hypertrophic nodular type, yield extremely well to radium. The excavating type is very intractable.

Sarcomata do well under radium if taken early, before metastasis.

Burying radium salts, or radium emanations should be resorted to whenever practicable, properly screened. Lymphosarcomata give excellent results.

Lymphadenoma, when confined to one or two small superficial areas —disappearance is frequently brought about by radium.

Bleeding in Fibroid Disease of Uterus is favorably affected by radium but seldom changes size of uterus. Exposure (up to 100 mgm.) from 30 to 60 hours, in 5 to 10 days, and the series repeated after 5 or 6 weeks. First symptoms of improvement is checking hemorrhage, until flow ceases or becomes normal.

Flat Superficial Naevi capillary nævi, "port wine stains," if blanching by gentle pressure is readily effected, the results of treatment will probably be satisfactory.

Cavernous Naevus is excellently improved under radium where crossfire radiation is possible.

Warts and Papillomata yield readily to short exposures—20 minutes to one hour. The reaction is slight and scar scarcely noticeable.

Tuberculosis of Glands not caseating where surgical measures have been declined for cosmetic reasons, radium proves of considerable value. Heavily screened exposure for 30 or more hours should be resorted to.

Skin Diseases. Keloids continue to give most excellent results.

Lupus Erythematosus, though very intractable and puzzling, often responds favorably to radium, even after all routine methods have failed.

Psoriasis and Chronic Eczema generally yield to short unscreened exposures, given on three successive days, the series of exposures being repeated at intervals of a fortnight.

Pruritus—The analgesic effect of radium is often of the greatest use in this disease, affording a degree of relief unattainable by any other method.

1050 PARK PLACE, BROOKLYN.

RADIOACTIVITY OF THE WATER AT HOT SPRINGS, ARK., AND SARATOGA SPRINGS, NEW YORK, AND OTHER POINTS IN AMERICA.

Probably the best known therapeutic springs in the United States are those at Hot Springs, Arkansas. At this place there are some forty-four different springs within an area of three acres, all owned by the United States Government, and administered by the Secretary of the Interior. The water from these springs has a temperature of from 35° to 64° C and contains about 275 to 280 parts of total solids per million. The daily outflow is estimated at about 800,000 gallons. The radioactivity of these springs was determined by *Boltwood**. The springs were found to be radioactive, the activity being due to the presence of radium emanation. Samples of the residue left when the water was evaporated showed no activity, indicating the absence of solid radioactive elements such as radium. The tufa deposits about the springs showed a very slight radioactivity amounting to about 0,003 micrograms radium per kilogram of material. Most ordinary soils contain several times this amount of

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*B. B. *Boltwood.* On the Radioactive Properties of the Waters on the Hot Springs Reservation, Hot Springs, Ark. Am. Journ. Science (4) vol. 20, pp. 128-32, 1905.

radium. As reported the emanation content of the water is stated in terms of the uranium equivalent of the radium in pitchblende. One gram of uranium in such ore is in equilibrium with 0.34 micrograms of radium element, this radium producing 0.34 microcuries of emanation. One microcurie of emanation per liter is equivalent to a concentration of about 2,700 mache units. In table 1 the concentration of emanation in the water from the various springs at Hot Springs is expressed first in microcuries per liter and then in mache units. The numbers referring to the springs are simply laboratory sample numbers and as far as the writer is aware, the Secretary of the Interior has never authorized the publication of the names of the springs in connection with the data as to their radioactivity.

TABLE I.

Radioactivity of Various Springs at Hot Springs, Ark.

Laboratory Sample Number.	Microcuries Radium Emanation per liter water.	Mache Units Emanation per liter water.	Laboratory Sample Number.	Microcuries Radium Emanation per liter water.	Mache Units Emanation per liter water.
22 A	0.00012	0.33	50 B	0.00027	0.74
23 A	0.00047	1.28	51 B	0.00017	0.47
24 A	0.00022	0.60	52 B	0.00002	0.05
25 A	0.00050	1.34	54 B	0.00005	0.13
26 A	0.00105	2.84	55 B	0.00026	0.71
27 A	0.00005	0.14	56 B	0.00003	0.07
29 A	0.00079	2.13	59 B	0.00042	1.15
30 A	0.00162	4.37	60 B	0.00022	0.60
32 A	0.00095	2.57	61 B	0.00047	1.26
33 A	0.00039	1.05	62 B	0.00049	1.32
34 A	0.00097	2.61	63 B	0.00321	8.66
35 A	0.00215	5.82	64 C	0.00086	2.32
36 A	0.00180	4.86	65 C	0.00048	1.29
37 A	0.00034	0.92	66 C	0.00101	2.71
38 A	0.00011	0.30	67 C	0.00033	0.90
39 A	0.00137	3.70	68 C	0.00086	2.32
40 A	0.00050	1.36	69 C	0.00132	3.56
41 A	0.00025	0.68	70 C	0.00876	23.65
43 A	0.00016	0.43	71 C	0.00056	1.51
44 A	0.00072	1.96	72 C	0.00049	1.32
45 A	0.00014	0.39		Cold Springs	
46 A	0.00029	0.78	73 D	0.00057	1.54
47 A	0.00077	2.09	74 D	0.00352	9.50
48 A	0.00016	0.43	Average	0.000877	2.37

These figures show that the spring waters at Hot Springs are notably radioactive. Taking an average—on the forty-four hot springs and the two cold springs represented by the samples, the activity amounts to 0.00088 microcuries per liter or 2.37 mache units.

For purposes of comparison the following data on the European springs is quoted from *Lazarus'* "Handbuch der Radium- Biologie und Therapie," (p. 199) :—

TABLE II.

(1)—Wildbad Gastein, (36.3 to 47.1°C).
Grabenbacker. . . . . 155.0 M.U.
Elisabethstollen, Hauptquelle. . . . . 133.0 "
Chorinsky-Quelle, Hauptstollen. . . . . 121.9 "
Wasserfall-Quelle. . . . . 106.0 "
Rudolf-Stollen. . . . . 68.8 "
Franz-Joseph-Stollen. . . . 64.5 "
Chirurgen-Quelle. . . . . 54.5 "
Fledermaus-Stollen. . . . . 32.8 "
Doktor-Quelle. . . . . 31.5 "

(2)—Badenweiler,
(22.5 to 27.5°C)... 7.5 to 10.1 "

(3)—Warmbrun,
(36.2°C). . . . . 5.2 to 8.2 "

(4)—Teplitz-Schoenau,
(21.9 to 32.5°C).. 9.0 to 26.0 "

(5)—Johannisbad,
(29°C). . . . . 0.24 to 4.04 "

(6)—Wildbad (Wurtt.),
(35.8 to 37.9°C)... 1.6 to 3.3 "

(7)—Villach, (29°C). 0.8 to 2.0 "

(8)—Ragaz-Pfaeffers,
(37.5°C). . . . . 0.33 to 0.76 "

(9)—Voslau, (24°C). . 0.7 to 0.71 "

(10)—Krapina-Teplitz,
(37 to 44°C)..... 0.665 "

(11)—Karlsbad,
(a) Muehlbrunnen. . . . . 31.5 "
(b) Vordere Quelle, Schlossburnnen. . . . 17.4 "
(c) Felsenquelle. . . . . 4.11 "
(d) Hinterer Muehlbrunnen. . . . 3.11 "
(e) Marktbrunnen. . . . . 2.45 "
(f) Franz Josephsquelle. 1.76 "
(g) Sprudel, (72.5°C)... 0.4 "

(12)—Mergentheim. . . . . 7.10 "

(13)—Marienbad,
(a) Waldquelle. . . . . 4.57 "
(b) Kreuzbrunnen. . . . 4.26 "
(c) Ambrosiusquelle. . . . 1.62 "
(d) Rudolphsquelle.1.09 to 0.66 "
(e) Ferdinandsbrunnen.. 0.66 "

(14)—Salzschlirf,
Bonifac. ca. . . . . 3. "

(15)—Salzig, Quelle 2. . . . . 1.4 "

(16) Passug, VII Quell 1.31 to 0.73 "

(17)—Tarasp,
(a) Carolaquelle. . . . . 1.13 "
(b) Lucius. . . . . 1.01 "
(c) Emerita. . . . . 0.93 "
(d) Bonifacius. . . . . 0.2 "

(18)—Baden-Baden,
(a) Buettquelle. . . . . 126.0 "
(b) Murquelle. . . . . 24.0 "
(c) Eight other springs 9.9 to 3.3 "

(19)—Kreuznach,
(a) Quelle a. Gradierhaus 256.8 "
(b) " 127.9 "
(c) " 527.6 "
(d) Inselquelle. . . . . 32.8 "
(e) Karlshaller Quelle.. 20.0 "
(f) Oranienquelle. . . . 17.4 "
(g) Elisabethquelle. . . . 13.0 "

(20)—Nauheim,
(a) Karlsbrunnen. . . . . 28.6 "
(b) Kurbrunnen. . . . . 25.4 "
(c) Three other springs, 16.2 to 0.29 "
Badestrudel VII. . . 1.8 "
" XII. . . 1.6 "
" XIV. . 1.5 "
..... etao shrdvb zbzb vbgk xzvzz

(21)—Munster a. St.
(a) Hauptbrunnen. . . . . 23.4 "
(b) Solquelle 2. ..... 13.65 "

(22)—Soden i. T.
(a) Champagnerbrunnen 21.9 "
(b-f) the remaining 5 springs. . . .16.4 to 0.79 "

(23)—Wiesbaden,
(a) Kurzquelle. . . . . 11.95 "
(b) Kochbrunnen. . . . . 1.23 "
(c) Schuetzenhofquelle . 7.8 "
(d) Pariser Hofquelle. . . 3.42 "
(e) Spiegelquelle. . . . . 0.8 "

(23)—Homburg,
(a) Elisabethbrunnen. . . 8.0 "
(b-c-d) the remaining 3 springs. . . . .4.0 to 2.3 "

(25)—Kissingen,
(a) Maxquelle. . . . . 4.3 "
(b) Rakoczy. . . . . 2.85 "

(26) Sulza, 5 springs. 5.15 to 1.16 "

(27) Landeck,
Georgenquelle. . . . . 206. "
Friedrichsquelle. . . . . 119.8 "
Wiesenquelle. . . . . 53.8 "
Marienquelle. . . . . 51.5 "
Mariannenquelle. . . . . 19.4 "
Trinkquelle. . . . . 2.6 to 1.7 "

(28)—Talheim. . . . . 16.3 "

(29)—Nenndorf,
Gewolbequelle. . . . . 20. "

(30 Aachen. . . . . (?)

(31) Pistyan,
Schopfbrunnen. . . . . 2.18 "
Schlammbassin a.d. Oberfl. . . . . 4.3 "
Bodensatz. . . . . 8.8 "

(32)—Baden b. Wien,
6 springs. . . . . 7.88 to 1.94 "

(33)—Trenczin-Teplitz,
Quelle I. . . . . 1.02 "
Gas. . . . . 1.59 "

(34)—Wellbach i. Taunus, 3.40 to 1.70 "

(35)—Alvaneu,
4 springs. . . . . 3.77 to 0.51 "

(36)—Baden b. Zurich,
15 springs. . . . . 0.58 to 0.03 "

(37)—Wildungen, Helenenquelle,
(264 to 246 Volt) ca. ... 2.5 "
George-Victor-Quelle (195 to 171 Volt. Plesch) ca. ..... 2.0 "

(38)—Joachimsthal,
Wernerlauf. . . . . 600.0 "

(39)—Franzenbad,
Franzensquelle. . . . . 8.16 "
Wiesenquelle. . . . . 3.52 "
Herkulesquelle. . . . . 3.13 "
Stephaniequelle. . . . . 3.08 "
Loimannsquelle. . . . . 2.82 "
Natalliequelle. . . . . 2.8 "
Eisenmineralmoor. . . . . 5.92 "

(40)—Altheide. . . . .2.48 to 1.15 "

(41)—Kudowa. . . . . 22.5 to 2.0 "

(42)—Leukerbad,
Lorenzqu. . . . . 0.26 "

(43)—Brambach. . . . .1,200 to 2,000 "

(44)—Plombieres-Capucins. . 12.8 "

(45)—Aix-les-Bains, Alun. .. 8.7 "

The waters of the springs at Saratoga Springs, New York, have long been esteemed for their therapeutic value. *Moore* and *Whittemore** have reported on the radioactivity of these waters. The waters of Saratoga Springs contain radium salts as well as radium emanation as shown in Table III, which is based on the data given by *Moore* and *Whittemore*.

*Journal of Industrial and Chemical Engineering, July, 1914, p. 552.

TABLE III.

Spring	Emanation in spring gas, microcuries per liter.	Emanation in spring water, microcuries per liter.	Concentration of Radium Emanation in spring water expressed in mache units per liter.	Radium in spring water, micrograms per liter.
Emperor	0.00022	0.00007	0.19	0.00006
Peerless	.....	0.00006	0.16	.....
New Red	0.00008	0.00004	0.11	.....
Hathorn No. 1.	0.00021	0.00014	0.38	0.00004
Coesa	0.00008	0.00009	0.24	.....
Hathorn No. 2.	0.00005	0.00016	0.43	0.0001
Hathorn No. 3.	0.00008	0.00006	0.16	.....
Geyser	0.00003	0.00004	0.11	.....
Adams	0.00011	0.00012	0.32	0.00005
Flat No. 2.	0.00003	0.00005	0.14	.....
Pump well No. 4.	0.00067	0.00023	0.62	0.00002
Island	.....	0.00011	0.30	.....
Crystal Rock.	0.00084	0.00088	2.38	0.000009
New shonts well.	.....	0.00011	0.30	.....

The radioactivity of some Colorado Springs has been determined by *Schlundt**, his results being given in Table IV. This table includes measurements made by *Schlundt* and *Moore*** on the radioactivity of several springs in the Yellowstone National Park.

TABLE IV.

Name of spring.	Temp.	Locality.	Mache units.
Eldorado	21.0	Eldorado Springs	3.25
Blue Bell	12.5	Blue Bell Canon	0.43
Red Rock	12.3	Boulder	2.49
Boulder Mineral	14.5	Crisman	3.74
Navajo	....	Manitou	3.36
Shoshone	14.9	Manitou	8.25
Navajo Geyser	13.0	Manitou	4.49
Iron Soda	14.7	Manitou (Mansion House)	3.74
Ouray	15.1	Manitou	1.41
Little Chief	17.2	Manitou	3.16
Ute Iron	10.2	Manitou	3.25
Manitou Soda	14.5	Manitou	3.04
Cheyenne Soda	12.7	Manitou	2.32
Seven Minute Geyser	12.8	Manitou	1.98
Ute Chief Magnetic	13.7	Manitou	1.35
Iron Springs Geyser	11.2	Manitou	2.34
Soda Spring	14.8	Steamboat Springs	0.43
Bath House Spring	39.5	Steamboat Springs	0.21
Navajo	13.0	Steamboat Springs	0.32
Iron	23.8	Steamboat Springs	2.39

*Journ. Phys. Chem., Vol. 18, p. 662.

**Bulletin No. 395, U. S. Geological Survey.

Craddock	....	Glenwood Springs	5.4
Apollinaris	9.2	Yellowstone Park	10.4
Nymph	....	Yellowstone Park	2.26

*Schrader** has measured the radioactivity of five different springs in the vicinity of Williamstown, Mass., and found them to contain radium emanation in amounts from 0.000009 to 0.000216 microcuries per liter of water (0.02 to 0.6 mache units). Tap water showed an activity of 0.000002 microcuries per liter. No radium salt could be found in the spring water, the activity being due to the emanation.

Boyle and *McIntosh*† tested water from springs in Western Canada, and found two occurring at Sinclair and Fairmount to contain respectively an amonut of radium emanation equal to 0.0040 and 0.0035 microcuries per liter (10.8 and 9.4 mache units), as well as a trace of radium salt.

The spring water at White Sulphur, W. Va., is radioactive containing** several mache units of emanation per liter.

REVIEWS AND ABSTRACTS

D. T. *Quigley,* M. D. Relation of Radium to Surgery. Medical Herald. Vol. 34, pp. 5-7, January, 1915. A paper read before the Medical Society of the Missouri Valley, at Colfax, Ia., September 18, 1914.

"With years of use and clinical study it was found that the radium owed its healing properties not so much to the weakly penetrating, but caustic soft beta and alpha rays, but to the exceedingly penetrating hard beta and gamma rays which were not nearly so irritating to normal tissue as the soft rays. This led to the working out of a scientific use of radium with screens, so that the maximum of efficiency with the minimum amount of irritation of normal tissue might be produced."

"In the hands of the unskilled the results as to the use of radium are unreliable and conflicting, but the results from the clinics where the radium is in the hands of experts, is so satisfactory as to assure radium a place as a useful addition to our therapeutic armamentarium."

"The effect of radium is not the same as the x-ray. It has several hundred times more penetration than the x-ray, the burns heal quickly, and with very little pain, and it has been found the best treatment for x-ray burns, x-ray eczema, and x-ray cancer is the application of radium."

"Mistakes have been made with radium by using too large a quantity. If an unreasonably large quantity be used and the exposure be too long the patient will be overwhelmed with broken down cells and the resulting auto-intoxication may hasten the death of the patient. Radium is a good thing used in reasonable dosage just as strychnine is a good thing used in reasonable dosage, but over-dosage of the one is just as unreasonable as over-dosage of the other."

"Two of the leading clinics of Europe have substituted radium for

*Phys. Rev. (2), Vol. 3, 339-45.

†Proc. Trans. Roy. Soc. Canada, (3), Vol. 7, p. 165.

**Personal communication from Dr. G. D. *Kahlo.*

the knife in the treatment of cancer, but in most of the European clinics and in my own work it has been reserved for inoperable cases and post-operative treatment. In most inoperable cases the results of the treatment are very gratifying, and beyond any other treatment. The first thing noticed is the disappearance of pain; this often occurs on the second or third day of treatment. The next thing is the drying up and disappearance of discharges and bleeding.; this occurs in from ten days to four weeks. The third effect is the shriveling up, and in some cases disappearance of the tumor mass; this shrinkage goes on for months after the treatment."

"Radium is indicated in every case of cancer. In the operable cases as a post operative treatment to prevent recurrence and in the inoperable cases to relieve distressing symptoms, prolong life, and as a possible cure."

"*Schauta* reports eleven clinical cures in twenty-two inoperable cases of cancer of the uterus, *Wertheim* six out of eighteen, other clinics in proportion. Besides a large number of inoperable cases have been brought into the operable class by the retrogression brought about by radium. No case of cancer or sarcoma should be considered hopeless unless radium has been tried, and in no case of cancer should radium treatment be neglected if it be possible for the patient to get the treatment. Radium should not supplant surgery in any operable case, but should be used in conjunction with surgery to get the best results. In skin cancer about the face, radium is to be preferred to the knife as hardly any scar is left, and the results are at least equal to surgery. In benign tumors the action of radium is well brought out by *Kelly's* recent article in the Journal A. M. A., in which he states he does not operate any more for fibroma or myoma, except in the small per cent. of cases where satisfactory retrogression of the tumor cannot be brought about by the use of radium."

"In keloid the action of radium is practically specific, as it is also in lupus and tubercular glands of the neck."

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Edmund W. *Clap*, M. D. Progress in Ophthalmology. Boston Medical and Surgical Journal, Vol. 172, No. 1, pp. 22-23, January 7, 1915.

"Radium in Ocular Therapeutics: *Koster* (Internat. Congr. Med. XVII), has secured favorable results from treatment of various eye diseases with radium and mesothorium. He began in 1905. After trying various methods he now uses a small glass tube containing five milligrams of radium bromide or four milligrams of mesothorium, though on the lids he sometimes uses a little ebonite box. The tubes are of thermometer glass with a little bulb blown on the end. Parenchymatous keratitis is treated from one-half to an hour, five to ten sittings with intervals of three, five, or seven days, according to the irritation. The cornea is not actually touched. The results were extremely favorable though other methods of treatment were used too. Leucomata of the cornea can be much thinned, and if not too thick to begin with, the sight is much improved. Scleritis is favorably influenced in connection with other treatment. Not much result was obtained in retinitis pigmentosa or optic atrophy. When the sight is blurred by products of past inflammation the radium treatment of the back of the eye has a good effect. Vitreous opacities and hemorrhages clear up considerably. Cataract secondary to uveitis or chorioditis is favorably influenced, but ordinary senile cataract is probably not changed by this treatment. Nævus pigmentosus and xanthelasma both disappear under treatment and

epithelioma were very successfully treated. All these diseases are either inflammations or hypertrophic growths, which accounts for the favorable action of radium in so many conditions."

"*Mattice* (Knapp's Archives, May, 1914), reports the treatment of an epithelioma of the cornea with the barium carbonate salt of radium. A mica box container was applied to the tumor mass for six minutes and in a week a twelve minute application was made. Six weeks after the first treatment the tumor remains were given a fifteen minute exposure. The tumor which had covered the cornea and involved the conjunctiva had disappeared and the vision had improved from light perception to twenty-seventieths."

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William Allen *Pusey*, M. D. Radium in Cutaneous Lesions. The Pennsylvania Medical Journal, November 1914, pp. 134-36. A paper read at the General Meeting of the Medical Society of the State of Pennsylvania, Pittsburgh Session, September 23, 1914.

"The rays from radium produce their effect upon living tissues by acting on the cells themselves, as is the case with the actinic rays of light and with X-rays. It is a direct effect upon the life-processes of the cells, which manifests itself first in a stimulation of these processes and, if carried further, in an overstimulation that may pass the boundries of repair and result in the destruction of the cells."

"As would be expected of such a reaction, tissues of greater vital activity are more sensitive to it and those tissues whose function is chiefly structural are least so; but no living cell is of such low vitality that it is beyond overstimulation by these rays, and a radium reaction may be so intense as to destroy any living tissue. Embryonic cells and many diseased cells are highly sensitive and quickly go on to overstimulation and destruction under the attack of these actinic rays."

"To limit our consideration to the effects upon the skin, or its analogue, mucous membrane (my field today), the manifestations of a radium reaction are seen first in the endothelium of the superficial vessels, and almost as soon in the more highly differentiated epithelium of the glands of the skin—the hair follicles, sebaceous glands and sweat glands; then in the deeper cells of the epithelial layer; and, after this, in the connective tissue structure of the skin."

"In a general way, these manifestations of the reaction first show as an over-stimulation of cellular activity, which quickly passes on to cell degeneration and destruction, with obliteration of small vessels in the skin, destruction of follicles, the formation of a necrotic pellicle on the surface epithelium, and, in the corium, in addition to the vascular changes, edema, round-cell infiltration and all the manifestations of an acute inflammatory reaction with destruction of some of the connective tissue elements. If there are diseased cells in the exposed area, such as a nodule of epithelioma, these are likely to succumb first to the attack. The extent to which the cells succumb depends upon their character and upon the intensity of the reaction. Unless the reaction has been carried beyond all bounds only the more susceptible cells succumb, while the less susceptible tissues i. e., surface epithelium and connective tissue stroma, which have not been destroyed gradually return to normal The resulting skin, while smooth and little changed on the surface, represents scar tissue. Capillaries and, it may be, larger blood vessels have been destroyed, compensatory hypertrophy has occurred in others (that accounts for the telangiectases in radium and X-rays scars), hair follicles, sweat glands and sebaceous glands have disappeared in part or entirely, and the more complex structure of the normal corium has been

replaced by connective tissue. If there were present in the area pathological tissues these too are likely to have been replaced by scar tissue."

"The foregoing summary represents accurately, but of course only in a broad way, the effects produced in the skin by exposure to radium rays, and it is easy to develop from a consideration of these effects the rational therapeutic indications of radium in skin diseases."

"1. Radium may be used, in short exposures, as a stimulant in certain dermatoses where the obscure effect of irritation in overcoming chronic inflammatory indurations has proved useful, as in patches of chronic eczema, in lupus erythmatosus, in lichen planus, and psoriasis. In these conditions and in others similar, it has been found of value. Of course the practical difficulty in its use in many of these conditions, and in others still to be considered, is the limited area of its application."

"2. Radium may be used to destroy hair follicles, sebaceous and sweat glands, blood vessels, and other highly differentiated structures in the skin. Sweat glands, sebaceous glands, and hair follicles may be destroyed with radium. It is however not a practical means for treating hyperidrosis, or acne, or for removing hairs for two reasons: (1). The limited quantities of radium available; (2). the permanent changes that are likely to be produced in the skin by exposures intense enough to destroy any of these follicles; these are atrophy with a tendency to the formation of dangerous keratoses, and disfiguring dilated capillaries or telangiectases."

"The important practical application of this therapeutic indication for radium is in nevi. The nonvascular nevi consists as a rule chiefly of an excessive formation of highly differentiated tissues (pigment cells, hair follicles, sebaceous follicles, endothelial cells) and their destruction by radium is a rational and practical procedure, which much experience has justified."

"In vascular nevi radium has perhaps its most nearly unique value. As was shown several years ago, it can be used with success for the destruction of the excess of blood vessels that constitute these lesions. It is most valuable in the flat port-wine marks, against which we have no other satisfactory method of treatment, unless it is in the application of x-rays with a most skillful technic. It is equally as effective for the treatment of nevi composed of larger blood vessels or thicker masses of blood vessels."

"3. Radium may be used to destroy masses of diseased cells in the skin. The most interesting field for the application of this therapeutic indication is in the treatment of epithelioma, and other carcinomas. In suitable cases radium offers an eligible method of treating epithelioma. The method is convenient for the physician and easy for the patient, the scars are as slight as possible, and the results permanent. The first essential of a suitable case for treatment with radium is that its successful treatment should not involve the destruction of contiguous glands; if the case is one in which conservative surgery requires the removal of neighboring glands, primary treatment with radium is not justified. The second essential is that the epithelioma should not extend beyond the limitations of application of the quantity of radium available for its treatment. Unless one has a relatively large quantity of radium the method is chiefly useful with small epithelomas, but extensive epitheliomas can be handled with even small quantities of radium by many prolonged applications."

"Of course warts, moles, senile keratoses, and many other tumors of the skin can be treated with radium with the same success as epitheliomas."

"In the foregoing I have only attempted to give an outline of the uses of radium in lesions of the skin. The subject can only be sketched in the few minutes that I may claim from you, and I have thought it best to touch upon the principles of its application and to outline its therapeutic uses as based upon these; for with a grasp of those principles one can readily deduce for himself its various possible applications."

"As a mater of fact these indications for the therapeutic uses of radium are exactly those of x-rays; and this brings us to the question of the relative value of the two agents."

"Various minor differences are indicated by different men between radium burns and x-ray burn; I have observed as carefully and as intelligently as I am able to do, burns of various degrees from both agents, and personally I do not believe these differences exist. The same is true, I believe, of their therapeutic results; they are in my opinion identical. In arguing for a difference, much stress is usually laid upon the point that a given case, usually an epithelioma, has failed to yield to x-rays and has yielded to radium, or *vice versa*. I have cured with x-ray literally scores of epitheliomas that gave histories of having failed of cure with x-rays and a few that gave the same history with radium; with the same argument upon my experience you would conclude that x-rays differed not only from radium rays, but also from themselves. The real fact is that a man succeeds with the one agent or the other according to his skill and judgment and experience in its use."

"Of course there are differences in the practical applications of the two agents, but these are not differences in their essence. Radium is easier of application, is adaptable to insertion in lesions, and the dosage with a given quantity of its salt is accurate; and these are valuable advantages at times. X-rays have the advantage of furnishing in an average apparatus an enormously greater amount of energy than is to be had from any available quantity of radium, and that is at times an enormous practical advantage for x-rays. On these practical advantages of the one agent or the other are based the differences in their value in different lesions."

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W. S. *Newcomet,* M. D. A Comparion of the Uses of the Roentgen Ray and of Radium, with Latern Demonstrations. The Pennsylvania Medical Journal, November, 1914, pp. 136-9. A paper read at the General Meeting of the Medical Society of the State of Pennsylvania, Pittsburgh Session, September 23, 1914.

"Some authorities have stated that the effect of the beta and gamma rays upon the human organism is exactly the same as the Roentgen ray. This point is open to question, for observation upon various cases seems to lead to different conclusions. Those experienced in both forms of radiation must be impressed by the difference in the character of the reaction produced; therefore, if the character of the local physiological reaction differs, necessarily the therapeutic action must be somewhat different."

"In this review the selection of cases for treatment with radium was taken from those for which radiation by the Roentgen ray was contraindicated; in most instances having been employed without success. Such cases as carcinoma of the rectum, vagina or uterus were chosen, also those occurring in the nasal or buccal cavities where the chief indication for the use of radium was the impracticability of applying Roeutgen radiation due to the difficulty of adjusting the apparatus in order to bring the field of radiation into view without injury to surrounding tissues. Several small epitheliomata occurred about the eve within a

few months after x-ray treatment and of that type which are occasionally seen where the ulceration is larger and healing more difficult with each recurrence. The period of quiescence was greatly increased in all that yielded. The true rodent ulcer must not be included in this class. On the other hand a type of case that seems to yield better results locally from the employment of the Roentgen ray is the recurrent carcinoma of the breast."

"Another point which supports the difference between the action of these two forms of radiation is the effect observed upon the laboratory workers. All suffer from the same hypertrophic and ulcerative conditions, but those resulting from radium and thorium are milder, are of shorter duration and show less tendency to become malignant; in fact x-ray burns have been treated by radium radiation. This may have a very important bearing upon the treatment of such benign growths as fibroids of the uterus, various forms of nevi and other tumors of similar nature. In the treatment of nevi splendid results are often obtained by radiation, but every case must be considered individually, as very often equally good results may be obtained by other procedures, employed under proper conditions."

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Joseph B. *Bissell,* M. D. The Intravenous Injection of Radium Element. The Pennsylvania Medical Journal. November, 1914, pp. 129-133.

"The field of our knowledge of the therapeutic uses of radium has been only scratched. Particularly is this statement true of the employment of radium in this country in hospital and private practice; and more especially does it apply to internal treatment. By internal treatment is meant the introduction into the human system by means of ingestion and injections of the radium element. For the purpose of discussion the scope of this paper will be confined to the instillation of radium into the blood of the veins."

"The intravenous method has the advantage of carrying directly through the body by means of the circulation a definite and accurately determined amount of radium. What exact change takes place in the metabolism of the human body we can only infer by observing the relations between cause and effect. Therapeutic action in agents administered in this manner should theoretically begin immediately and results ought to be obtained much more quickly than by any other less direct method of administration. Dr. Frederic *Proescher* has determined by means of his valuable experiments among humans as well as animals that the radium is carried through the body when injected intravenously, and is deposited in the form of carbonates and sulphates. A small amount of radium is excreted, the greater portion, however, being deposited in the bone marrow. The human organization therefore becomes actively radioactive. To quote Dr. *Proescher,* 'in other words the body becomes a vital emanatorium due to the deposit of radium salts.' How active the radiation is depends, I presume, upon the amount of radium retained in the body. What the limit of safety is I am unable to state. In some forty patients treated by me the highest amount given a patient at one time was 100 micrograms of radium and the smallest amount 50 micrograms. I believe that with much larger doses I would have obtained more satisfactory results, but the experiment being new to me I had to proceed with caution."

"The technic of the injection is very simple. For each injection radium in the form of bromide is dissolved in physiological sterile salt

solution in a sealed glass ampulle. The injections are given into one of the larger veins at the fold of the elbow, by means of an all-glass sterile syringe. To perform this little operation easily the veins are distended by means of a firm rubber tube twisted around the middle of the upper arm. The needle, separated from the syringe, is inserted into the distended vein, a steady stream of blood showing when insertion is perfect. Every drop of the radium solution is sucked into the syringe and the air expelled. The syringe is inserted into the bleeding needle, the tourniquet removed, and the fluid slowly injected. Pain is very slight or not present at all, and only caused by the prick of the needle through the skin into the vein. Local reaction, if present, is very slight, and in most cases there is none whatever. These injections were given for various pathological conditions."

This paper is entirely a clinical one and deals only with the cases in the author's experience, recording the changes which follow the injections of the radium element into the blood in the form of a solution of the bromide salt.

"From a study of these patients the following facts concerning radium therapy may be assumed: Radium injected into the veins relieves pain; it improves the blood picture in anemic and cachectic patients; it causes absorption of deposits around chronically infected joints; it reduces high blood pressure, lessens the coagulation time, and has a certain definite effect as a hypnotic."

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George D. *Kahlo*, M. D. The Use of Natural and Artificially Prepared Radioactive Solutions in Internal Medicine. The Pennsylvania Medical Journal, November, 1914, pp. 126-129. A paper read at the General Meeting of the Medical Society of the State of Pennsylvania, Pittsburgh Session, September 23, 1914.

"It is generally conceded, I think, that the effects of mineral waters can not be explained on the basis of their chemical analyses alone, and it has frequently been observed that very similar results may be obtained from waters of widely different chemical constitutions. To many the explanation of these phenomena is in the volume of water ingested and in the accessory measures of treatment employed, which usually include treatment by bath, diet, systematic exercise, massage and certain other agencies, which constitute what has become popularly known as "a cure." Others, however, believe that even minimal quantities of salts existing in a natural state are of importance by reason of their greater subdivision rendering them more readily absorbed; and the suggestion has been made that possibly the difference observed between the natural and artificial solutions of this nature are due to variations in electrical conductibility of their molecular elements."

"Since the discovery that certain mineral waters are possessed of the property of radioactivity, the attempt has been made to explain much that has hitherto seemed unaccountable on such an hypothesis. In support of this contention it has been pointed out that many waters of feeble mineralization and of known therapeutic potency have a high degree of radioactivity. Such a supposition would seem tenable at least in the stronger waters; for example, those of Bad Gastein, the physiological effects of which bear a very close resemblance to those of radium when employed in other forms, but I believe that this same influence may be seen in waters possessing this property even in slight degree, although it may seem a little premature to make any positive pronouncements of this nature."

"I have, unfortunately, no data to offer in proof of such a con-

tention, nor, as far as I am aware, have others working in this field been able to do this. But an experience of some years in balneologic practice in different places, together with considerable opportunity of observing the work of others, forces upon me this conviction. One factor that has influenced me in forming such an opinion, in addition to the results obtained from certain seemingly indifferent waters, has been the fact, long since observed, that mineral waters are generally less potent in their action when taken in bottled form than when used at their source, this difference being due, I believe, in part at least to the loss of radium emanation."

"Another point to be considered in this connection is that water of different springs, the chief chemical ingredients of which are practically the same, although differing slightly in some of their minor ingredients, are often found to have widely different physiological effects. Still another, and to my mind even more important, is that condition in which radium therapy finds its chief indications, and in which good results have been most constantly observed, are for the most part the same as those in which mineral waters have been found to act most favorably, notably those associated with disturbance of metabolism."

"In the light of our present knowledge, however, we are hardly justified in assuming that comparatively slight degrees of radioactivity are without influence any more than that seemingly infinitesimal quantities of salt are insufficient to produce their characteristic physiological effect."

"Radioactive mineral waters when offered for sale in bottles, however, are misleading; for, as is well known, this property although present in considerable degree when the water is taken from the spring disappears in about the ratio of fifty per cent. in the first four days, ninety per cent, after twelve days, and in approximately a month's time is lost entirely. All physicians who are seekers after the truth will earnestly support any effort to safeguard the public against misbranding in any form. This does not apply, however, to solutions containing radium element."

"Mineral waters owe their radioactivity in most cases to radium emanation existing in the form of gas and not to the presence of radium element; hence, as has already been pointed out, the results to be expected from this influence are more or less ephemeral. In order to utilize this influence, therefore, it is necessary that they be taken at their source. Of all means of introducing radium emanation into the system, that by the ingestion of natural radioactive mineral water is the simplest and, in many cases, the most reliable method. Mineral waters when taken at frequent intervals covering a period during which such treatments are usually given, produce an effect upon metabolic changes which is quite as certain and probably as lasting as when radium emanations are introduced in any other form."

"Used in this way, also, the effects of radium emanation are supplemented by those of the salts contained in the water. The effects of radium baths are, I am inclined to think, mainly those of the inhalation of emanation given off by the water, and are modified by the temperature and duration of the emersion. I have also employed to some extent emanation in other forms, but my experience has not been sufficiently convincing as to the benefits to be derived from these measures whether their source be from artificial solutions or from natural mineral waters to warrant any positive conclusion. It need hardly be reiterated, however, that it is difficult to separate the effects of different measures employed together, and with a class of patients

such as a majority of those with which I have to deal, one cannot employ a single therapeutic agent, as I have seen done in the clinics abroad."

"Of the diseases in which I have observed the best results from radium therapy in its various forms, gout, unquestionably, stands first, and particularly is this true, I think, as regards the effects of radioactive mineral waters. I must repeat, however, that these results are probably in considerable measures attributable to the salts contained in the water, and to some extent, also, to the increased amount of fluid ingested, as well as to dietic restrictions and baths, which, in most cases, have been employed in conjunction therewith."

"Rheumatoid arthritis ranks perhaps second. In my own experience some cases have shown decided improvement, while in others the results have been disappointing, even though the effect of the mineral water has been supplemented by baths, inhalations and the drinking of artificially charged waters. Rheumatism is less certain in its response to these measures, although good results are frequently observed."

"I have for many years been impressed with the influence of alkaline mineral waters in the treatment of diabetes, an influence hardly less important, I believe, than the regulation of diet. This probably is, I believe, also largely attributable to the effects of radium emanation in modifying metabolic changes, as in gout and other intoxication."

"Radio-chalybeate waters act most favorably in the various forms of anemia, an effect which has been observed in radium therapy in other forms, and hardly to be accounted for by the iron salts alone. Neuritis, neuralgia and other diseases of the nervous system depending upon toxic influences are likewise quite generally benefited by radioactive mineral waters."

"Acute conditions and severe forms of some of the diseases already referred to, when existing in debiliated subjects, are, in general, contraindications for the employment of either mineral waters or radium treatment. The exact status of radium therapy has yet to be determined, and much additional data based upon further scientific research, combined with a wider clinical experience, is necessary before we can form positive conclusion. Especially is this true, I think, as regards the effects of radium emanation derived from mineral waters. All that we can say at present is that probably some of the effects of mineral waters of this type are due to this property, but how much and to what extent these are contributed to or modified by other constituents of the water remains to be proven."

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Frank L. *Hess*. Radium. The Journal of Industrial and Engineering Chemistry, Vol. 7, No. 2, February, 1915. Separate from Part 1, Mineral Resources, 1913, pp. 363-4. "The production of carnotite bearing ores during 1913 was the largest to date, and amounted to about 2,269 short tons of dry ore, which contained about 81,990 pounds of U_3O_8 equivalent to 34.8 tons (31,560 kilograms) of metallic uranium. *Rutherford* has estimated that the quantity of radium in equilibrium with uranium is about 1 gram of radium to 3,000 killograms of uranium, and workers in the Bureau of Mines have estimated that the uranium in carnotite is accompanied by about 90% of the radium required for equilibrium. On the supposition that these figures are approximately correct and that 90 per cent of the radium present is recoverable, then the ores produced contained 8.5 grams of recoverable metallic radium, equivalent to 15.9 grams of hydrous radium bromide $RaBr_2 2H_2O$ valued, at $120,000 a gram of metallic radium, at $1,020,000."

"Of the carnotite ores produced, 1,125 dry tons, carrying 36,022 pounds of U_3O_8 and 3.7 grams of radium, equivalent to 7 grams of hydrous radium bromide, were kept in this country, and 1,134 dry tons, carry 45,068 pounds of U_3O_8 and 4.8 grams of radium, equivalent to 8.9 grams of hydrous bromide, were shipped to Europe."

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Isaac *Levin,* M. D. The Local Application of Radium in Surgery. Pennsylvania Medical Record, November, 1914. (c.f. "Radium," Nov., 1914, for abstract of article appearing in the Medical Record of October 10th, 1914, pp. 615-20).

NOTES AND COMMENTS.

The following is quoted from the British Medical Journal of January 16th, 1915:

"The Manchester Radium Committee has now in its possession radium of the value of 20,000 pounds, and it has spent an additional sum of about 1,000 pounds in bringing the department up-to-date in its equipment. The stock of radium is to be kept in a special fireproof strong room at the Manchester Infirmary, which, with other rooms required for the department, has been provided rent free by the Board of Management. In addition to the rooms where treatment will be carried out, there is a laboratory and work shop with electrically driven lathe and mercury pumps used in the making and preparing of emanation tubes and applicators. Although the stock of radium is thus to be kept at the infirmary, it will be available for use by any of the hospitals of Manchester, Salford, and neighboring towns which have participated in the scheme, or patients from these hospitals can be sent to receive their treatment at the infirmary."

"The department will be worked in close connection with the Cancer Research Laboratory under Dr. Powell *White,* the staff of which will thus be enabled to carry out extensive experimental work. Dr. Arthur *Burrows,* who was assistant at the Radium Institute, London, has been appointed radiologist to the department, and Mr. *Lupton,* late of the Physical Laboratory of the University, has been appointed physicist. Mr. *Lupton* thus succeeds Dr. *Marsden,* who has recently received the appointment of Professor of Physics in the University of Wellington, New Zealand. With these appointments the department is now ready to begin work.

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The Rockefeller Institute for Medical Research will receive $200,000, under the will of Henry *Rutherford,* for cancer research work.

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Mr. A. *Fleck,* demonstrator at the University of Glasgow, has been appointed physical chemist to the Glasgow Radium Committee, established to administer a large fund collected in the city for the purpose of acquiring and distributing radium for therapeutic purposes. A radiometric laboratory, under the auspices of the committee, has been fitted up at the University.

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Mr. Frederick *Soddy,* F. R. S., lecturer in physical chemistry and radioactivity, in the University of Glasgow, has been appointed to the

chair of chemistry of the University of Aberdeen, in succession to Professor F. R. *Japp*. Professor *Soddy's* contributions in the field of radioactivity and radiochemistry have been of fundamental importance. Professor *Soddy's* book, "The Interpretation of Radium," (G. P. Putnam's Sons), gives the best presentation of the subject in nontechnical language, for the interested lay reader, and his book on the "Chemistry of the Radio-Elements" (Longmans, Green and Co.) gives in great detail what is known on this subject.

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Dr. William S. *Newcomet* will direct the work of the newly established radium department at Jefferson Hospital, Philadelphia, Pa.

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The year 1914 was an eventful one in the industry of mining radium, uranium, and vanadium ores showing by far the largest year's production yet made. Figures collected by Frank L. *Hess*, of the U. S. Geological Survey, indicate that the output amounted to about 4300 short tons of dry ore carrying 87 tons of uranium oxide and 22.4 grams of metallic radium. The ore was valued at about $445,000. The ore produced in 1913 contained 41 tons of uranium oxide and 10.5 grams of radium, and that produced in 1912 contained 26 tons of uranium oxide and 6.7 grams of radium. About 90% of the contained radium is thought to be recoverable under improved processes.

In Utah the Standard Chemical Co. made the first commercial production of carnotite ores from the Henry mountains during the year, and the commercial production of uvanite, a radium-bearing mineral new to science, accompanied by other uranium minerals, one or more of which are yet to be described, was begun at Temple Rock, 45 miles southwest of Green River. Shipments were made from newly opened carnotite deposits at Court House, northwest of Moab, Utah, and from deposits 16 or 18 miles southeast of Moab. A first shipment was also made from Blue Mountain, Routt county, Colorado.

The Paradox valley region was, however, as usual, the chief producing area, and from it came the bulk of the ores. The Standard Chemical Co. was the largest single producer, and shipped more than half of the country's output.

Two companies, the Standard Chemical Co. and the Radium Company of America, produced radium salts during the year, and W. A. *Schlesinger* started a radium-refining laboratory. The European war stopped nearly all operations in both mines and reduction plants; for the two companies mentioned sold their product largely in Europe and practically all the ore bought by brokers was sold abroad. A little more than 1200 tons of ore, containing 28.1 tons of uranium oxide and 7.2 grams of radium, was consigned to Europe, but as the foreign refineries were closed, a part of it was held in transit.

No vanadinite or similar ores are known to have been sold for vanadium during the year.

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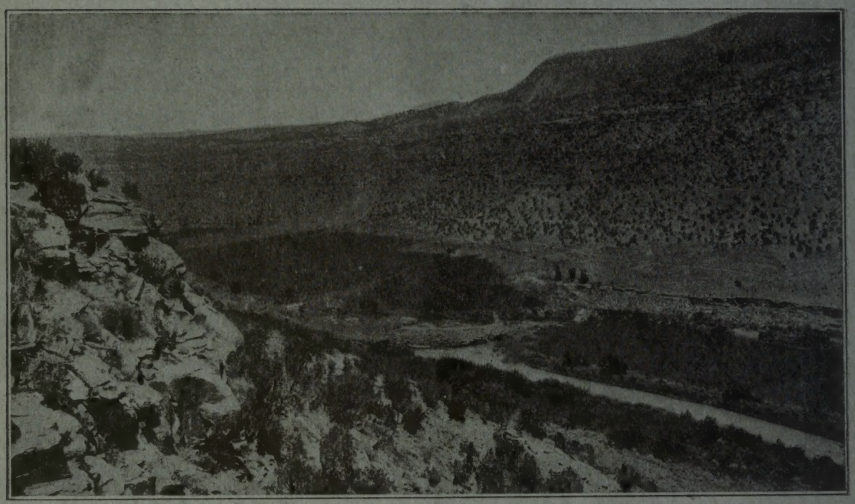

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